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The impact of risk factors for coronary heart disease on related disability in older Irish adults

Authors

Sharon M. Cruise, PhD^{1,2*}

John Hughes, MSc^{2,3}

Kathleen Bennett, PhD⁴

Anne Kouvonen, PhD^{2,5,6}

Frank Kee, MD^{1,2}

Affiliations

¹ Centre for Public Health, School of Medicine, Dentistry and Biomedical Sciences, Queen's University Belfast, Institute of Clinical Science B, Royal Victoria Hospital, Grosvenor Road, Belfast, BT12 6BJ, Northern Ireland, United Kingdom

² UKCRC Centre of Excellence for Public Health (NI), Centre for Public Health, Queen's University Belfast, Belfast, UK

³ Northern Ireland Statistics and Research Agency (NISRA), Belfast, UK

⁴ Department of Pharmacology and Therapeutics, Trinity Centre for Health Sciences, St James's Hospital, Dublin, Ireland

⁵ Department of Social Research, University of Helsinki, Helsinki, Finland

⁶ SWPS University of Social Sciences and Humanities, Faculty in Wroclaw, Wroclaw, Poland

* Corresponding author: Dr Sharon Cruise, Centre for Public Health, Institute of Clinical Sciences Block B, Queen's University Belfast, Royal Victoria Hospital, Grosvenor Road, Belfast, BT12 6BJ, Northern Ireland, United Kingdom. Email: s.cruise@qub.ac.uk; Phone: 0044 (0)28 90971607; Fax: 0044 (0)28 90235900

Running head

Impact of CHD risk factors on related disability

The impact of risk factors for coronary heart disease on related disability in older Irish adults

Abstract

Objectives: To examine the prevalence of CHD-related disability (hereafter ‘disability’), and the impact of CHD risk factors on disability in older adults in the Republic of Ireland (ROI) and Northern Ireland (NI). **Methods:** Population attributable fractions were calculated using risk factor relative risks and disability prevalence derived from The Irish Longitudinal Study on Ageing and the Northern Ireland Health Survey. **Results:** Disability was significantly lower in ROI (4.1% vs 8.8%). Smoking and diabetes prevalence rates, and the fraction of disability that could be attributed to smoking (ROI:6.6%;NI:6.1%), obesity (ROI:13.8%;NI:11.3%), and diabetes (ROI:6.2%;NI:7.2%), were comparable in both countries. Physical inactivity (31.3% vs 54.8%) and depression (10.2% vs 17.6%) were lower in ROI. Disability attributable to depression (ROI:16.3%;NI:25.2%) and physical inactivity (ROI:27.5%;NI:39.9%) was lower in ROI. **Discussion:** Country-specific similarities and differences in the prevalence of disability and associated risk factors will inform public health and social care policy in both countries.

Keywords: coronary heart disease, disability, risk factors, relative risk, population attributable fractions (PAFs)

The impact of risk factors for coronary heart disease on related disability in older Irish adults

Introduction

The island of Ireland has seen a decline in mortality from coronary heart disease (CHD) (Bennett et al., 2006; Bennett, Hughes, Jennings, Kee, & Shelley, 2013); however, Irish CHD mortality rates are still amongst the highest in Europe (Bennett et al., 2006; European Health for All; Levi et al., 2009). A recent report forecasts increases of 50% for the Republic of Ireland (ROI) and 30% for Northern Ireland (NI) between the years 2007 and 2020 in the numbers of adults who will ever have CHD (Balanda, Barron, Fahy, & McLaughlin, 2010). These increases in CHD are thought to be a result of both increasing populations (in terms of general population growth) and larger proportions of those populations who are in older age groups. As CHD is one of the leading causes of disability in older adults (Ebrahim, Wannamethee, Whincup, Walker, & Shaper, 2000; Adamson, Lawlor, & Ebrahim, 2004; Oldridge & Stump, 2004), increasing prevalence of CHD represents a key issue for public health and for health and social care services in a climate of limited health care resources.

One island, two healthcare systems

The island of Ireland presents a unique opportunity to examine differentials in CHD prevalence and CHD-related disability. The one island incorporates two countries, the Republic of Ireland (ROI) and Northern Ireland (NI) (the latter being a part of the United Kingdom), and although the two populations are similar in terms of ethnic and cultural background, diet, and lifestyle, each country has an independent health and social care system: the ROI's is largely health insurance-based, but in some instances is a combination of public and private health services; while the majority of the population of NI is eligible to free healthcare under the United Kingdom's National Health System (NHS). There is mixed evidence for the impact of the differing healthcare systems on healthcare utilisation. For example, some studies (e.g., McGregor & O'Neill, 2007; Ward et al., 2009) have found that GP consultation and hospitalisation rates are much the same in both countries in spite of the availability of free healthcare in NI, while other studies (e.g., O'Reilly et al., 2007; Layte & Nolan, 2015) have found evidence of unmet need in some socioeconomic groups in ROI as a result of having to pay for GP appointments.

Risk factors for CHD and CHD-related disability

The associations between CHD and specific risk factors such as smoking, obesity, and physical inactivity are well established (World Health Organization, 2009; Yusuf, Reddy, Ôunpuu, & Anand, 2001a, 2001b). However, the literature that focuses specifically on risk factors for CHD-related *disability* is sparse. One of the few studies that considered the role of specific functional limitations after CHD onset, the Whitehall II study, found that of five lifestyle-related factors examined (obesity, smoking, alcohol, diet, physical inactivity), obesity and physical inactivity were most strongly associated with disability both pre- and post-onset of CHD (Britton, Brunner, Kivimaki, & Shipley, 2012). If, as in the Whitehall study, we consider CHD as a mediator between various risk factors and subsequent disability, we can examine the effects of risk factors such as current smoking, obesity, physical inactivity, and diabetes (Yusuf et al., 2001a, 2001b) on CHD-related disability. The effects of depression on CHD are more complex and the literature is inconsistent. However, there are a number of studies that have found depressive symptoms to be associated with the onset of symptoms of CHD (Hemingway & Marmot, 1999; Wulsin & Singal, 2003), and the Global Burden of Disease Study (Charlson, Stapelberg, Baxter, & Whiteford, 2011) has flagged depression as a risk factor for CHD. Therefore, the present study will include depression as a risk factor for CHD and CHD-related disability.

Country-level differences in risk factors for CHD and CHD-related disability

Although there is a great deal of similarity between the populations of ROI and NI in relation to ethnic background, diet, culture, etc., previous studies have shown country differences in the prevalence of some of the risk factors for CHD. For example, Ward et al. (2009) found higher obesity levels in ROI's 65+ population compared to NI, as well as higher smoking rates. However, Ward et al. (2009) found the NI population to be more sedentary than those in ROI.

NI has a long-established, higher prevalence of mental ill-health compared with the rest of the UK (O'Reilly & Browne, 2001). Furthermore, McGee et al. (2005) found that four times more people in NI (compared to ROI) scored in the clinically significant range for depression (as measured by instruments such as the CESD and the GHQ12, 8% vs 2%). The higher depression level in NI is not unexpected – the well-documented 'Troubles' (a period of political conflict with accompanying civil unrest and violence that lasted from 1968 to 1998) are posited to have impacted on the psychological health of many in NI, especially those who

lived (and still live) near contentious regions and peace walls (O'Reilly & Stevenson, 2003; Maguire et al., 2016). Although individuals living in the border areas of ROI (i.e., alongside the border with NI) during the period of the Troubles may have experienced some of this unrest and violence, the majority of the ROI population would not have been exposed.

Therefore, given the country-level variations in risk factor prevalence shown in previous studies, it is reasonable to hypothesise some differences in how they may impact on CHD-related disability.

Socioeconomic differences as risk factors for CHD and CHD-related disability

A social gradient in cardiovascular morbidity and mortality is evident in most developed countries (Wilkinson & Marmot, 2003), and it has been suggested that some (though not all) of the socioeconomic inequality in cardiovascular mortality and disability can be explained by a social gradient in conventional risk factors such as smoking and obesity (Beauchamp et al., 2010). Therefore, it is not unreasonable to anticipate some socioeconomic differentials in CHD prevalence, and in the impact of risk factors on CHD-related disability when stratified by socioeconomic position (SEP). Furthermore, differences in access to free healthcare between the two countries may also be an important determinant of CHD and CHD-related disability.

Therefore, the objectives of the study were: i) to assess the extent to which disability associated with CHD varies by age, gender, and SEP in ROI and NI; and ii) to compare the contribution of risk factors including smoking, diabetes, obesity, physical inactivity, and depression to CHD-related disability, stratified by age, gender, and SEP.

Methods

Samples

Information on CHD-related disability and risk factor prevalence, for estimation of relative risks, were sourced from high quality nationally representative studies.

The Irish Longitudinal Study on Ageing (TILDA) is a cohort study of ageing that is being carried out in ROI among a sample of more than 8,000 respondents aged 50 years and over. Detailed descriptions of the TILDA cohort, including study design and methodology, are

described elsewhere (Kearney et al., 2011; Whelan & Savva, 2013). Further information is available at the TILDA website (www.tilda.ie) and the Irish Social Science Data Archive (ISSDA) website (www.issda.ie) where the data are available on application. The present study used Wave 1 TILDA data which was collected between October 2009 and February 2011.

The Northern Ireland Health Survey (NIHS) is a cross-sectional population-based health survey that has been carried out annually in NI from 2010/11 among respondents aged 16 years and over. More information about the NIHS is available on the Northern Ireland Statistics and Research Agency (NISRA) website (<http://www.csu.nisra.gov.uk/surveyNIHS.asp5.htm>) and on the UK Data Service website (<https://discover.ukdataservice.ac.uk/catalogue/?sn=7258>) where the data are available on application. NIHS data used in the present study were collected during 2010/2011.

The response rate for both TILDA and the NIHS was 62%.

Pooled data

To provide more robust estimation of relative risks the datasets were merged to provide a pooled, all-Ireland sample after harmonisation of all variables being used in the analyses.

Weighting

The TILDA and NIHS each have a population weighting variable that was applied to analyses involving the individual datasets in order to ensure that estimates were representative of the populations from which the samples had been drawn. TILDA weighting was based on age, gender and educational attainment; NIHS weighting was based on age and gender. It was not possible to apply the country-specific population weights to relative risk (RR) analyses involving the pooled dataset; however, all RR analyses were adjusted for gender, age, and SEP (i.e., the characteristics that are typically used to establish population weights).

Variables

CHD-related disability (disability)

In order to define CHD-related disability it was first necessary to establish prevalence of CHD. During the TILDA and NIHS computer-assisted personal interviews (CAPI), the

respondent was shown a list of health conditions (which included ‘angina’ and ‘heart attack’) and asked to select any conditions that applied to them. In the present study, a respondent was deemed to have CHD if they indicated having had either angina or a heart attack.

The second step in defining CHD related disability was to establish prevalence of limiting long-term illness (LLTI). The LLTI questions in the TILDA and NIHS were broadly similar (see Table 1). In the present study, a respondent was deemed to have a LLTI if they responded ‘yes’ to questions 1 and 2.

Table 1. Questions used to derive limiting long-term illness (LLTI) in TILDA and NIHS

TILDA	NIHS
<p>Some people suffer from chronic or long-term health problems. By long-term we mean it has troubled you over a period of time or is likely to affect you over a period of time.</p> <p>1. Do you have any long-term health problems, illness, disability or infirmity? NOTE: INCLUDING MENTAL HEALTH PROBLEMS (yes/no)</p> <p>2. Does this illness or disability limit your activities in any way? (yes/no)</p>	<p>1. Do you have any long-standing illness, disability or infirmity? By “long-standing” I mean anything that has troubled you over a period of time or that is likely to affect you over a period of time? (yes/no)</p> <p>2. Does this illness or disability limit your activities in any way? (yes/no)</p>

Respondents were deemed to have CHD-related disability if they had both CHD and a LLTI. Hereafter, CHD-related disability will be referred to as disability.

Risk factors

Five established risk factors were included in the study and coding for these variables was standardised across the two datasets in order to facilitate merging of datasets. How each risk factor was defined is described below.

Smoking status (i.e., current smokers vs never smoked [reference]) and whether the respondent had diabetes (yes vs no [reference]) was derived from information provided during the CAPI (i.e., self-report) for both TILDA and NIHS.

Respondents' body mass index (BMI) categorisations (derived from anthropometric measurement of weight and height in both TILDA and NIHS) were based on the World Health Organization's (WHO) classifications of underweight (<18.5), normal weight (18.5 - 24.99 kg/m²), overweight (25 - 29.99 kg/m²), and obese (>30 kg/m²). In order to ensure adequate sample sizes in each category the underweight and normal categories were aggregated into one category. This paper focuses on obesity versus the underweight/normal group.

Respondents were categorised as 'physically inactive' (low levels of physical activity) versus 'physically active' (moderate or high levels of physical activity) based on their responses to the International Physical Activity Questionnaire Short Form (IPAQ; Craig et al., 2003) which was administered during the CAPI for both TILDA and the NIHS. Note that although the IPAQ categories were available as a derived variable in the TILDA dataset, the meta-data did not make clear how it had been derived; therefore, we derived our own IPAQ categories using raw data in TILDA thus ensuring comparability with our treatment of the NIHS IPAQ data (using the authorised IPAQ scoring protocol – see <https://sites.google.com/site/theipaq/scoring-protocol>).

In TILDA, depression was assessed during the CAPI using the 20-item version of the Center for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977). The CESD was designed to screen for depressive symptomatology during the seven days preceding assessment. A threshold of ≥ 16 on the total scale score is suggested as representing depression in the clinical range (Radloff, 1977). In the NIHS, depression was assessed using the General Health Questionnaire (GHQ12; Goldberg & Williams, 1988), a measure of common mental disorders for use in population studies. The GHQ12 was self-administered during the CAPI (i.e., there is a section of the NIHS CAPI where the interviewer hands the participant the computer and allows them to self-complete the more sensitive components of the questionnaire). A score of ≥ 4 on the total scale score has been suggested as an appropriate threshold to determine a mental disorder in the clinical range Mari & Williams,

1985). Respondents were classified as depressed (i.e., scores at or above the recommended threshold) versus not depressed (i.e., scores below the recommended threshold).

Sociodemographic/socioeconomic variables

For the purposes of describing the age distribution of the sample, and estimating the prevalence of disability stratified by age, 10-year age bands were used (50-59; 60-69; 70-79; 80+). For the purposes of estimating relative risks (RRs) and population attributable fractions (PAFs), age was categorised as a dichotomous variable (50-64 and 65+). This was to maximise sample size/cell counts, and thus preserve power for RR estimation.

The present study used occupational group as an indicator of socioeconomic position (SEP). The NIHS used the National Statistics Socio-Economic Classification (NS-SEC) that is traditionally used by the UK's Office for National Statistics (ONS); the occupational coding used in TILDA is similar to that used by Ireland's Central Statistics Office (CSO) for the census. When deriving a SEP variable for our analyses, we had to ensure that the indicators of SEP between the two countries were comparable. The three SEP groups (professional/managerial [high]; lower non-manual [medium]; manual [low]) were broadly similar; however, in the NIHS there was a group of individuals coded as 'no socioeconomic group (SEG), armed forces, etc.' who were difficult to place. In TILDA there was a separate group for 'farmers' that was equally difficult to place. Excluding these two groups altogether or keeping them as separate SEP groups was not an option because of the effect this would have on sample/cell sizes (especially in the NIHS). Therefore, we made the decision to compare the distributions of these respective groups against the distributions of the manual SEP group using alternative indicators of SES (e.g., educational level, housing tenure, household income). For both the 'farmers' group in TILDA and the 'no SEG' group in the NIHS the distributions using alternative measures of SES were broadly similar to the distributions of the respective TILDA and NIHS manual SEP groups. Therefore, the decision was taken to include each of these two categories with the respective country-specific manual groups.

Additionally, TILDA included a sizeable 'not applicable' category (n=2,323). As 78% of this group were women, we thought it possible that they had never worked outside of the home and therefore could not be allocated to a specific occupational group. The decision was taken to treat this 'not applicable' group as a separate and independent group with no

counterpart in the NIHS rather than try to absorb them within one of the three SEP categories. There was also a ‘missing/refused’ group in TILDA with quite large numbers (n=796) which was difficult to integrate into the 3-category SEP variable and which was kept as a separate SEP group. Therefore, within both health surveys we had a 3-category SEP indicator (high, medium, low) that was broadly similar and that allowed us to make meaningful comparisons and ultimately pool data, but within TILDA there were two additional groups (‘not applicable’; ‘missing/refused’) that were retained in order to maximise sample size.

Ethics

This study was approved by the School Research Ethics Committee in the School of Medicine, Dentistry and Biomedical Sciences, Queen’s University Belfast (Reference Number 14/03). This study involved secondary data analysis, therefore there was no direct contact between the study team and respondents in either health survey, and all data had been anonymised at source. All aspects of the project were carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for research involving humans, with written, informed participant consent being obtained by the respective owners of the data prior to each survey taking place.

Statistical analysis

Basic prevalence comparisons across the two datasets were based on Chi-squared tests for contingency tables. Prevalence analyses for risk factors were stratified by gender, age, and SEP. Binomial regression models with a log link were used to derive RRs for risk factors on disability using the pooled, all-Ireland dataset. Each regression model was fully adjusted for all other risk factors and sociodemographic variables. Risk factor prevalence and RR estimates for NI and ROI were combined in order to calculate PAFs for each risk factor. Prevalence and relative risk analyses were conducted in Stata 12 (StataCorp, 2011); calculation of PAFs was conducted in Microsoft Excel.

Results

Sociodemographic characteristics of the two samples

The TILDA sample comprised 8162 respondents aged 50 and over; the NIHS sample comprised 2020 respondents aged 50 and over. Overall, the distribution of men and women

was more balanced in TILDA (48% and 52% respectively) than in NIHS (38.3% and 61.7%) which had a higher proportion of women (population weighted percentages) (see Fig 1).

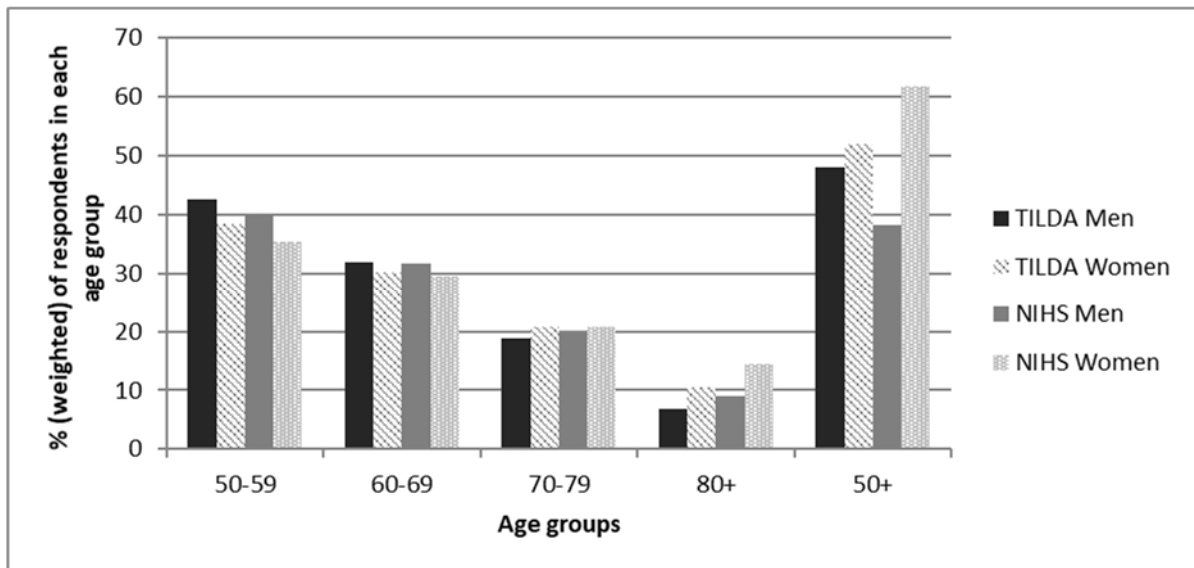


Figure 1. Percentage (weighted) of men and women in each age group in TILDA and NIHS

Results indicate a broadly similar distribution of respondents by age group in the two surveys; however, there was a slightly higher proportion of respondents aged 80 and over in NIHS than in TILDA (12.3% vs 8.7% respectively) which was to be expected given ROI's younger population profile. As anticipated, there was a gradient of decreasing proportions of older respondents, and the proportion of women increased with age. This was evident in both datasets (see Fig 1).

Disability

Of the 668 and 273 respondents in TILDA and NIHS (respectively) who reported having CHD, 308 and 191 (TILDA and NIHS respectively) reported having concurrent limitations measured as LLTI. This represents a disability prevalence of 4.1% and 8.8% (weighted) for the ROI and NI samples respectively ($p < 0.001$). As shown in Table 2, the prevalence of disability was also significantly higher in NIHS for men and women, across all age groups, and for the high, medium, and low SEP groups. Men had a slightly higher prevalence of disability in both countries, and the prevalence of disability increased with age in both countries. The highest prevalence of disability among the SEP categories was for the low

SEP group, followed by the high group, with the medium group having the lowest levels of disability. This pattern was consistent in both countries.

Table 2. Distribution of CHD-related disability in TILDA compared with NIHS by gender, age group, and SEP (n=weighted %)

		TILDA		NIHS	
		N	n (%)	N	n (%)
All		8162	308 (4.1)	2020	191 (8.8)***
Gender	Men	3739	166 (4.4)	921	100 (10.0)***
	Women	4423	142 (3.7)	1099	91 (8.1)***
Age	50-59	3270	45 (1.6)	661	25 (4.0)***
	60-69	2589	101 (4.2)	687	65 (8.9)***
	70-79	1677	114 (6.9)	466	69 (13.6)***
	80+	626	48 (8.3)	206	32 (15.2)***
SEP	High	1799	50 (2.9)	297	24 (7.6)***
	Medium	953	21 (2.2)	651	41 (5.9)***
	Low	2291	112 (5.0)	1072	126 (11.1)***
	Not applicable [§]	2323	110 (5.1)	-	-
	Missing/refused [§]	796	15 (2.2)	-	-

*** $P \leq 0.001$; [§] These categories apply to TILDA only

Prevalence and population attributable fractions for risk factors

Table 3 shows the prevalence, RRs, and PAFs for current smoking, obesity, physical inactivity, diabetes, and depression for disability in ROI and NI.

Overall prevalence for current smoking and diabetes were broadly comparable in the two countries, and the results of PAF analyses indicated that the impact of these risk factors on disability was modest. When analyses were stratified by gender, age group, and SEP, some variations were evident: PAFs for current smoking in women were higher than for men in both countries; PAFs for current smokers aged 65 and over were lower in both countries than for those aged 50-64, while PAFs were higher for those with diabetes aged 65 and over than those aged 50-64; and there was a gradient of increasing prevalence of current smoking with increasing deprivation (lower SEP) for both countries, though this pattern was not evident in the PAFs which showed a counterintuitive pattern of decreasing amounts of disability attributable to current smoking with increased levels of deprivation.

Table 3. Prevalence, relative risks (95% CIs), and population attributable fractions (PAFs) for all CHD risk factors stratified by age group, gender, and socioeconomic position (SEP)

		TILDA	NIHS	All-Ireland RRs	PAFs using all-Ireland RRs & country-specific prevalence	
Risk factor		%	%	RR (95% CIs)	ROI	NI
Current smoking	All	19.8	18.0	1.36 (1.05, 1.75)	6.6	6.1
	Men	19.7	19.6	1.19 (0.82, 1.71)	3.6	3.6
	Women	19.8	17.1	1.54 (1.08, 2.19)	9.6	8.4
	50-64	23.2	23.9	1.39 (0.92, 2.10)	8.3	8.6
	65+	14.9	11.3	1.26 (0.90, 1.75)	3.7	2.8
	High SEP	13.0	11.1	1.60 (0.74, 3.47)	7.3	6.3
	Medium SEP	14.5	13.3	1.35 (0.61, 3.00)	4.8	4.5
	Low SEP	20.5	22.9	1.09 (0.75, 1.58)	1.7	1.9
Obesity	All	35.2	28.2	1.45 (1.08, 1.96)	13.8	11.3
	Men	38.0	32.4	1.52 (0.97, 2.37)	16.4	14.4
	Women	32.6	25.3	1.36 (0.90, 2.06)	10.6	8.4
	50-64	34.5	28.6	2.11 (1.12, 3.97)	27.7	24.1
	65+	36.3	27.7	1.29 (0.92, 1.81)	9.5	7.4
	High SEP	31.7	25.0	1.49 (0.72, 3.09)	13.4	10.8
	Medium SEP	29.8	24.8	0.64 (0.30, 1.39)	*	*
	Low SEP	36.0	31.4	2.05 (1.27, 3.33)	27.5	24.9
Physical inactivity	All	31.3	54.8	2.21 (1.83, 2.67)	27.5	39.9
	Men	24.9	50.7	**		
	Women	37.2	57.4	2.49 (1.85, 3.33)	35.6	46.0
	50-64	25.8	46.8	2.26 (1.60, 3.17)	24.5	37.0
	65+	39.1	64.0	2.20 (1.76, 2.76)	32.0	43.5
	High SEP	28.9	49.8	2.58 (1.61, 4.14)	31.4	44.0
	Medium SEP	28.8	50.7	2.47 (1.43, 4.27)	29.8	42.8
	Low SEP	27.9	58.8	2.14 (1.63, 2.83)	24.2	40.2
Diabetes	All	8.1	9.6	1.81 (1.47, 2.23)	6.2	7.2
	Men	9.7	11.4	**		
	Women	6.6	8.4	1.58 (1.12, 2.24)	3.7	4.7
	50-64	6.1	7.0	1.91 (1.23, 2.99)	5.2	6.0
	65+	11.0	12.5	1.77 (1.39, 2.25)	7.8	8.8
	High SEP	6.7	8.3	1.99 (1.16, 3.41)	6.2	7.6
	Medium SEP	5.8	8.4	2.21 (1.23, 3.94)	6.5	9.2
	Low SEP	9.6	10.7	1.74 (1.30, 2.33)	6.6	7.3
Depression	All	10.2	17.6	2.92 (2.35, 3.63)	16.3	25.2
	Men	7.4	16.2	3.19 (2.36, 4.32)	14.0	26.2

Women	12.7	18.4	2.64 (1.93, 3.61)	17.3	23.3
50-64	11.0	22.7	4.07 (2.68, 6.18)	25.2	41.1
65+	9.0	11.7	2.60 (2.00, 3.37)	12.6	15.7
High SEP	5.6	15.1	1.80 (0.89, 3.63)	4.3	10.8
Medium SEP	6.6	17.1	1.94 (0.95, 3.95)	5.9	13.8
Low SEP	8.5	18.6	3.64 (2.69, 4.93)	18.4	32.9

RRs: relative risks; CIs: confidence intervals; PAFs: population attributable fractions; LLTI: limiting long-term illness; ROI: Republic of Ireland; NI: Northern Ireland; SEP: socioeconomic position

* PAF estimates indicated no risk (i.e., $RR < 1.0$)

** Unable to estimate RR as regression model failed to converge

The prevalence of obesity was notably higher in ROI than in NI and this pattern was consistent across gender, age group, and SEP. However, this higher prevalence did not equate to markedly higher PAFs for NI. For both countries, variation was evident when the analyses were stratified by gender, age group, and SEP: men had higher prevalence and PAFs for obesity than women, those aged 50-64 had higher PAFs than those aged 65 and over; and those in the low SEP group had higher prevalence and twice the amount of disability attributable to obesity compared to respondents in the high SEP group.

The prevalence and PAFs for both physical inactivity and depression were notably higher for NI than for ROI, in many instances being more than twice as high. This pattern was consistent for both risk factors when the analyses were stratified by gender, age group, and SEP. In both countries, those aged 65 and over had a higher prevalence of physical inactivity but a lower prevalence of depression compared to those aged 50-64. The prevalence of physical inactivity in those in the low SEP group in NI was markedly higher than for those in the high SEP group. There were clear SEP gradients for depression in both countries, with between 3 and 4 times (for NI and ROI respectively) the amount of disability being attributable to depression for those in the low SEP group compared to those in the high SEP group.

Discussion

The present study had two main objectives: firstly, to assess the extent to which disability associated with CHD varies by age, gender, and SEP in ROI and NI; and secondly, to

compare the contribution of smoking, diabetes, obesity, physical inactivity, and depression to CHD-related disability in models that were stratified by age, gender, and SEP.

The findings showed that disability was significantly higher in NI than in ROI, and that this difference across the jurisdictions was consistent across gender, all age groups, and all SEP groups. At a population level it has been suggested that the higher prevalence of CHD in NI compared to ROI can be explained by the higher proportion of older people in NI and differences in socioeconomic patterning in the two countries (Balanda et al., 2010). Our data showed a higher proportion of respondents aged 80 and over and a lower ratio of men:women in NIHS than in TILDA, reflecting the NI population profile. The prevalence of disability increased with age, and this pattern was more apparent in NI, which is unsurprising as NI has higher rates of CHD and higher proportions of older people (the latter being represented in our representative NIHS sample).

There was no evidence of a clear-cut social gradient in the prevalence of disability in either ROI or NI; however, in both countries the prevalence of disability was highest in the lowest SEP group, followed by the highest SEP group, with the medium SEP group having the lowest prevalence of disability. This finding supports numerous studies that demonstrate the impact of inequalities on health outcomes (Balanda et al., 2010; Beauchamp et al., 2010; Bajekal et al., 2013; Sacker, Head, & Barley, 2008), but the absence of a linear trend across SEPs emphasises the need to go beyond the traditional explanations that are invoked for the type of social patterning of health outcomes that are more often observed. Given the seriousness of CHD as a health condition, and the cross-sectional nature of the present study, it is possible that we are seeing evidence of survivor bias (i.e., prevalence of disability is lower in the middle SEP group because those with more serious CHD in the lower SEP groups have not survived).

Findings indicated few, if any, country differences in smoking and diabetes – both countries had similar prevalence of these risk factors overall and when stratified by gender, age group, and SEP group. However, the use of the 50-64 and 65 years and over age bands obscured country-specific differences in current smoking that became evident among those aged 75 and over and 80 years and over when disaggregated. Although each of these age groups, in both countries, had the lowest prevalence rates for current smoking compared to the younger age groups, in each case the prevalence rates for ROI were double those of NI. There are

country-level differences in public health strategies to encourage smoking cessation which may explain the higher smoking prevalence in ROI compared to NI which has been observed in the present study, and other studies. For example, there are a range of free smoking cessation services available to smokers in NI, including face-to-face pre- and post-quit services, with follow-up over 4 weeks of non-smoking, and access to counselling services. Additionally, nicotine replacement therapy and prescription drugs to support cessation are freely available via community-based pharmacies and GP services. Smoking cessation services in ROI are not as comprehensive as in NI, and NRT is only freely available to select high-risk groups and those who do not pay prescription charges.

Furthermore, the PAFs suggest that whilst current smoking was a risk factor for disability for both men and women aged 50 and over, the contribution for women was greater in both countries. These findings are contrary to those of some previous studies (Matthews et al., 1989; Bonithon-Kopp, Scarabin, Darne, Malmejak, & Guize, 1990); however, a recent study found that smoking was associated with earlier onset of myocardial infarction in women, and perhaps an earlier age of onset of heart disease in women smokers allows for a longer period during which associated disability may manifest (Bähler, Gutzwiller, Erne, & Radovanovic, 2012).

There were higher levels of obesity in ROI which were reflected in the proportion of disability attributed to obesity in this country compared with NI. This finding corresponds with previous studies (e.g., Ward et al., 2009). There were also large between-country differences for physical inactivity and depression, with NI having considerably higher rates compared to ROI, which supports the findings of other studies (e.g., Ward et al., 2009; McGee et al., 2005). In the present study, these differences remained when analyses were stratified by gender, age group, and SEP. Women had higher levels of physical inactivity and depression in both jurisdictions, and those aged 65 and over had lower prevalence of obesity, smoking, and depression. Men had slightly higher rates of diabetes than women in ROI and NI, which is congruent with other studies (Rosner Preis et al., 2009). There was evidence of health inequalities in both countries for most of the risk factors, with those in the low SEP group having the highest prevalence of current smoking, obesity, physical inactivity (NI only), diabetes, and depression. Therefore, risk factors for disability also showed clear evidence of inequalities, and mirror the findings of other studies (Balanda et al., 2010; Beauchamp et al., 2010; Bajekal et al., 2013; Sacker et al., 2008).

Strengths of the present study

This study benefited from the use of two large representative national samples which permitted analyses that would not otherwise have been possible given the low prevalence of disability associated with CHD. Both samples were population-based and therefore could be weighted, which renders the findings more generalisable. For the most part the pertinent variables were comparable across the two datasets, or could be re-coded so as to make them sufficiently comparable. Finally, deriving our own RRs allowed us to weight, adjust, and stratify to suit the requirements of the study, as well as to evaluate the robustness of estimates, and eliminate possible biases that the use of published RRs might have introduced.

Limitations of the present study

There were some limitations with sample size and small cell counts, especially in the NIHS, when stratifying disability prevalence, which were addressed by merging the TILDA and NIHS datasets on pertinent variables and using only the pooled data to establish RR estimates; by aggregating age to two groups; and by minimising the level of stratification. In most instances this was sufficient to provide robust estimates. Furthermore, RRs for each risk factor were derived from cross-sectional data; therefore, caution is advised when making inferences regarding causality of the risk factors on future disability. Estimating RRs from longitudinal data would be less prone to bias, but the direction and magnitude of any bias is uncertain. On the one hand, some risk factors like smoking may raise risks for both mortality and CHD-related disability, and such “high risk” individuals may be under-represented in any cross-sectional dataset of “survivors” (implying that we might have underestimated the RR for disability). On the other hand, the degree and direction of bias is even more uncertain for a risk factor like obesity which has a non-linear relationship with survival, and which may even confer a lower risk after a first incident event (Romero-Corral et al., 2006).

The study did not specifically consider co-morbidities in relation to disability. The only exception to this was the adjustment for diabetes in all the RR regression models. Therefore, it is important to view the PAFs for each risk factor as being representative of only an element of possible overall disability that a person may experience. Furthermore, we did not consider the severity of CHD or disability.

We have assumed that a respondent had disability if they reported having CHD and a LLTI. In truth, especially at older ages, LLTI may be as a result of co-morbid conditions such as

musculoskeletal disorders or respiratory problems (Ayis, Gooberman-Hill, Ebrahim, & MRC Health Services Research Collaboration, 2003), and thus we may be over-estimating the prevalence of disability that can be specifically attributed to CHD. Conversely, the present study may have provided a more conservative estimate of disability as it was focused on samples of community-dwelling older adults and did not include those in residential care who are likely to have higher rates of chronic and limiting illness.

Further limitations include the use of self-reported measures of CHD, disability, and risk factors; the use of different measures of depressive symptomatology in TILDA compared with the NIHS – the GHQ12 is a more global measure of common mental disorders whereas the CESD is specifically focused on depression; and different administration of the depression measures: interviewer-administered in TILDA and self-administered in the NIHS.

Policy implications

The results of the present study reinforce the importance of increasing levels of physical activity and maintaining healthy weight in order to ameliorate the impact of CHD on disability, areas that are the central focus of cardiovascular-related public health initiatives both in ROI and NI (Department of Health & Children, 2010; Department of Health, Social Services & Public Safety Northern Ireland [DHSSPSNI], 2014). Furthermore, in the present study depression had strong associations with CHD-related disability, though the mechanisms of its effects in people with CHD are not clearly understood, and its role in the manifestation of disability is complex. There are, therefore, clear imperatives to focus future research on understanding the role of depression as it affects CHD and disability, and to continue efforts to support population-wide and patient focussed psychological well-being.

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Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

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Author contributions

All authors contributed to the conception or design of the study, and to the acquisition, analysis, or interpretation of the data. SMC drafted the manuscript. All authors critically revised the manuscript, gave final approval, and agree to be accountable for all aspects of the work, ensuring integrity and accuracy.

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